TWO NEW GENERA OF SILURIAN PHACOPID TRILOBITES

by R. B. RICKARDS

ABSTRACT. *Delops* and *Struveria*, two new genera of trilobites, are defined. Certain species hitherto placed in the genus *Dalmanites* s.l. are referred to these genera and to the subfamily Zeliszkellinae Delo 1935. The evolutionary relationships are briefly discussed. The following are described: *Delops obtusicaudatus* (Salter), *D. nobilis nobilis* (Thomas), *D. n. marri* subsp. nov., and *Struveria howgillensis* sp. nov.

THE species *Delops obtusicaudatus* (Salter) was first recorded by Sedgwick (1845, p. 446) as *Asaphus caudatus*. Its phacopid affinities, however, were quickly appreciated by Salter (1849) and M'Coy (1851) who described it respectively as *Phacops obtusicaudatus* and *Phacops* (*Odontochile*) *obtusicaudata*. M'Coy (1851) was the first worker to figure the species. Salter, in his Monograph of British Trilobites (1864), provided further and better figures of the species under the name *Phacops* (*Odontochile*) *obtusicaudatus*. It is here considered the type of *Delops* gen. nov.

At this time the only known locality for this form was Coldwell Quarry in the Lake District but recordings from further afield were later made by Aveline (*in* Aveline and Hughes 1872, 1888) and Marr (1878). In this last paper Marr (pp. 883, 885) also recorded, and briefly described, *Phacops obtusicaudatus*, var. from the Upper Coldwell Beds. A specimen of this form, placed by Marr in the Sedgwick Museum, Cambridge (specimen number A38594), clearly shows that it is referable to *Dalmanites* s.s. Marr (1892, p. 537) recorded *P. obtusicaudatus* from Troutbeck (Lake District) and Helm Knott (south of Sedbergh) in addition to the type locality. Furthermore, he listed '*Phacops torvus* Wyatt-Edgell, M.S.' from Troutbeck and Helm Knott. The form which Marr recorded from Helm Knott as *P. obtusicaudatus* is conspecific with his '*Phacops torvus* Wyatt-Edgell, M.S.' and the two are here considered to form a new subspecies, *Delops nobilis marri*.

Thomas (1900) described *Phacops* (*Dalmania*) *nobilis* from the Wenlock Shale near Builth.

Following this date the Sedbergh forms received mention in several works. Thus, from Cautley (north of Sedbergh), Marr (1913, pp. 12, 17) recorded the following: *Phacops* (*Dalmannites*) *obtusicaudatus*, *Phacops* (*Dalmannites*?) sp. 1, and *Phacops* (*Dalmannites*) sp. 2. These forms are conspecific and also belong to the subspecies *D. nobilis marri* subsp. nov.

A form related to *Delops* gen. nov. and hitherto overlooked is described herein as *Struveria howgillensis* gen. et sp. nov.

The writer considers that *Delops* and *Struveria* show affinities with Zeliszkellinae Delo 1935. The glabellar lobation of *Struveria* is distinctly primitive and of the *Dalmanitina* type. *Struveria* is, therefore, placed alongside *Dalmanitina* and *Eudolatites* in the *Dalmanitina*-group of the Zeliszkellinae. In the case of *Delops* the frontal glabellar lobe when viewed from above transgresses the anterior cephalic border, a feature common

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in the Zeliszkellinae but absent in the Dalmanitinae. *Delops*, however, has a peculiar combination of biocharacters, some of which are typical of older genera and others of younger genera, which make its systematic emplacement more difficult. The glabellar lobation in particular distinguishes *Delops* from members of the *Dalmanitina*- and *Zeliszkella*-groups, and it is best considered as a separate group within the Zeliszkellinae. By contrast, the *Zeliszkella*-group contains two genera and the *Dalmanitina*-group three.

It is thought probable that *Delops* has been derived from a member of the *Dalmanitina*-group by the development of some typically Silurian and Devonian phacopid features and partial retention of earlier characters.

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Abbreviations associated with catalogue numbers of specimens are as follows: BM, British Museum (Nat. Hist.); SM, Sedgwick Museum; OUM, Oxford University Museum; HUR, Hull University, Rickards Collection.

SYSTEMATIC DESCRIPTIONS

Class TRILOBITA Walch 1771
Order PHACOPIDA Salter 1864
Family DALMANITIDAE Vogdes 1890
Subfamily ZELISZKELLINAE Delo 1935
Delops-group nov.

Representatives. The group is monotypic.

Differential diagnosis. Distinguished from *Zeliszkella*-group by the frontal lobe protruding beyond the cephalic margin; by the prominent genal spines; by the relatively large pygidium and by the glabellar lobation. The large, centrally situated eyes, non-mucronate pygidium, and large genal spines distinguish the *Delops*-group from the *Dalmanitina*-group of the Zeliszkellinae.

Genus DELOPS gen. nov.

Type species. Phacops obtusicaudatus Salter 1849.

Other species. Delops nobilis nobilis (Thomas) and *D. nobilis marri* subsp. nov.

Derivation of name. In honour of D. M. Delo.

Diagnosis. Exoskeleton moderately large and tuberculate; cephalon semicircular in outline with prominent genal spines; border furrow well developed except anteriorly where it, and the margin, is transgressed by a swollen frontal lobe; eyes large, crescentic, close to glabella and extending from 3p to region of 1p furrows; glabella club-shaped, axial furrows moderately diverging, 1p furrows with traces of adaxial bifurcation; 2p furrows transversely straight, deep, but do not reach axial furrows, resulting in fusion of the 2p and 3p lobes; 3p furrows well defined, straight, diverging anteriorly; facial suture cuts

the lateral cephalic margin approximately opposite the 2p furrows; pygidium in the shape of an obtuse-angled isosceles triangle, non-mucronate, pygorachis strongly convex, nine to thirteen axial rings, six to nine pygidial pleurae; pygidial margin either entire or with slight lateral denticles seen both on internal and external moulds; doublure either rounded or flat.

Remarks. The peculiar association of biocharacters is sufficient to distinguish *Delops* from other described genera. *Delops* almost certainly represents a specialized late offshoot from the *Dalmanitina*-group. It differs from *Dalmanitina* (*Dalmanitina*), *D.* (*Chattiaspis*), and *Eudolatites* in the lobation of the glabella. Thus in *D.* (*Chattiaspis*) the frontal lobe is contained within the cephalic margin, whilst in *D.* (*Dalmanitina*) the adaxial bifurcation of the 1p grooves and the convergence of the 1p and 2p grooves is more pronounced than in *Delops*. In both *D.* (*Dalmanitina*) and *Eudolatites* the axial furrows widen more prominently than in *Delops* where they are slightly re-entrant at the 3p grooves. *Delops* has deeper 3p furrows than *Eudolatites* in which the frontal lobe is scarcely detached from the central area. There are superficial resemblances to several other genera, but the complete lack of an anterior border makes for easy distinction from *Dalmanites* and *Odontochile*, whilst the pygidial characters are quite unlike any of the Dalmanitinae. Some of the later genera such as *Greenops*, *Neometacanthus*, &c., have similar posterior lobation of the glabella but the nature of the frontal lobe in *Delops*, as well as the unusual pygidium, is sufficient to distinguish it from these forms.

Delops obtusicaudatus (Salter 1849)

Plate 84, figs. 1, 2

1845 *Asaphus caudatus* Sedgwick, p. 446.
1849 *Phacops obtusicaudatus* Salter, p. 7.
1851 *Phacops* (*Odontochile*) *obtusi-caudata* Salt. sp.; M'Coy *in* Sedgwick and M'Coy, p. 161, pl. 1G, figs. 15, 16.
1852 *Phacops* (*Odontochile*) *obtusicaudatus* Salter; Salter *in* Sedgwick and M'Coy, appendix A, p. ii.
1864 *Phacops* (*Odontochile*) *obtusicaudatus* Salter; Salter, pp. 45–46, pl. 1, figs. 42–45.

Lectotype (here selected). Headshield figured by M'Coy 1851, pl. 1G, fig. 15 and refigured herein as Plate 84, fig. 1. The specimen is now housed in the Sedgwick Museum, Cambridge, SM A38682.

Horizon and locality of lectotype. Coldwell Beds, Coldwell, Westmorland.

Dimensions of lectotype. Length of glabella 15 mm.; max. width, glabella 13 mm., postero-lateral cephalic margin 15 mm.

Other material. Specimens in Sedgwick Museum, Geological Survey Museum, British Museum (Nat. Hist.).

Horizon and localities. Middle Coldwell Beds, Upper Coldwell Beds, Lake District; Coldwell Quarry; west of Hundreds Road, near Skelgill; Troutbeck, Westmorland; Coniston, Lancashire.

Diagnosis. Exoskeleton moderately large, tuberculate, and with a prominent doublure; cephalon semicircular, anterior border interrupted by protruding frontal glabellar lobe, genal spines present, border furrow well developed except anteriorly; eyes large, crescentic, lensed surface extending from anterior-most part of 3p lobes to midway between 2p and 1p furrows; cephalic axial furrows widen steadily from occipital ring;

1p, 2p, and 3p lobes graduated and increasing in size anteriorly, 2p and 3p lobes fused abaxially so that 2p furrows do not reach axial furrows; frontal lobe large, swollen, protruding beyond anterior cephalic margin, with a posteriorly positioned pit; whole cephalon ornamented with coarse tubercles; pygidium relatively large, well segmented, pygorachis with eleven to thirteen axial rings, and pleural regions with nine pleurae; pygidial margin entire and doublure rounded.

Description. The cephalon is approximately semicircular in outline, moderately convex, and has free cheeks which slope steeply to the prominent border.

The genal spines are relatively short, reaching a length equal to about half that of the glabella. Both the cephalic margin and the border furrow are transgressed by the frontal lobe of the glabella, but otherwise the border is a distinctive feature and is ornamented by the same kind of large tubercles as the rest of the cephalon. Details of these tubercles are not easily ascertained since they are usually 'streaked out'. The eyes are large and similar to those in *Dalmanites* but are not as centrally situated on the cheeks and are positioned rather more anteriorly. The posterior branch of the facial suture is directed towards the lateral cephalic margin which it cuts at a level midway between the 2p and 3p furrows.

A distinctive feature of *D. obtusicaudatus* is the glabellar lobation. Owing to compression the fusion of the 2p and 3p lobes is only occasionally seen, but the gradation in size from the 1p to 3p lobes is always discernible. The 1p and 2p lobes are quadrangular and the 3p lobes triangular. The 3p furrows diverge anteriorly and bound the swollen frontal lobe. In most of the specimens examined the frontal lobe just transgresses the frontal cephalic margin but the nature of preservation often makes it difficult to assess the part played by distortion. The frontal lobe is collapsed in several instances, and in some of these cases the anterior cephalic margin is visible from above.

Thoracic segments have not been seen.

The pygidium is relatively large, has eleven to thirteen rings on the pygorachis, and about nine pleurae in each of the pygidial pleural fields. Both pleural and interpleural furrows are well developed. An important feature of the pygidium is the entire margin and rounded doublure (see Pl. 84, figs. 2*a*, *b*). At the anterior end the pygorachis is approximately one-third of the total width of the pygidium, and its posterior extremity reaches to the margin. None of the specimens examined show any signs of tuberculation

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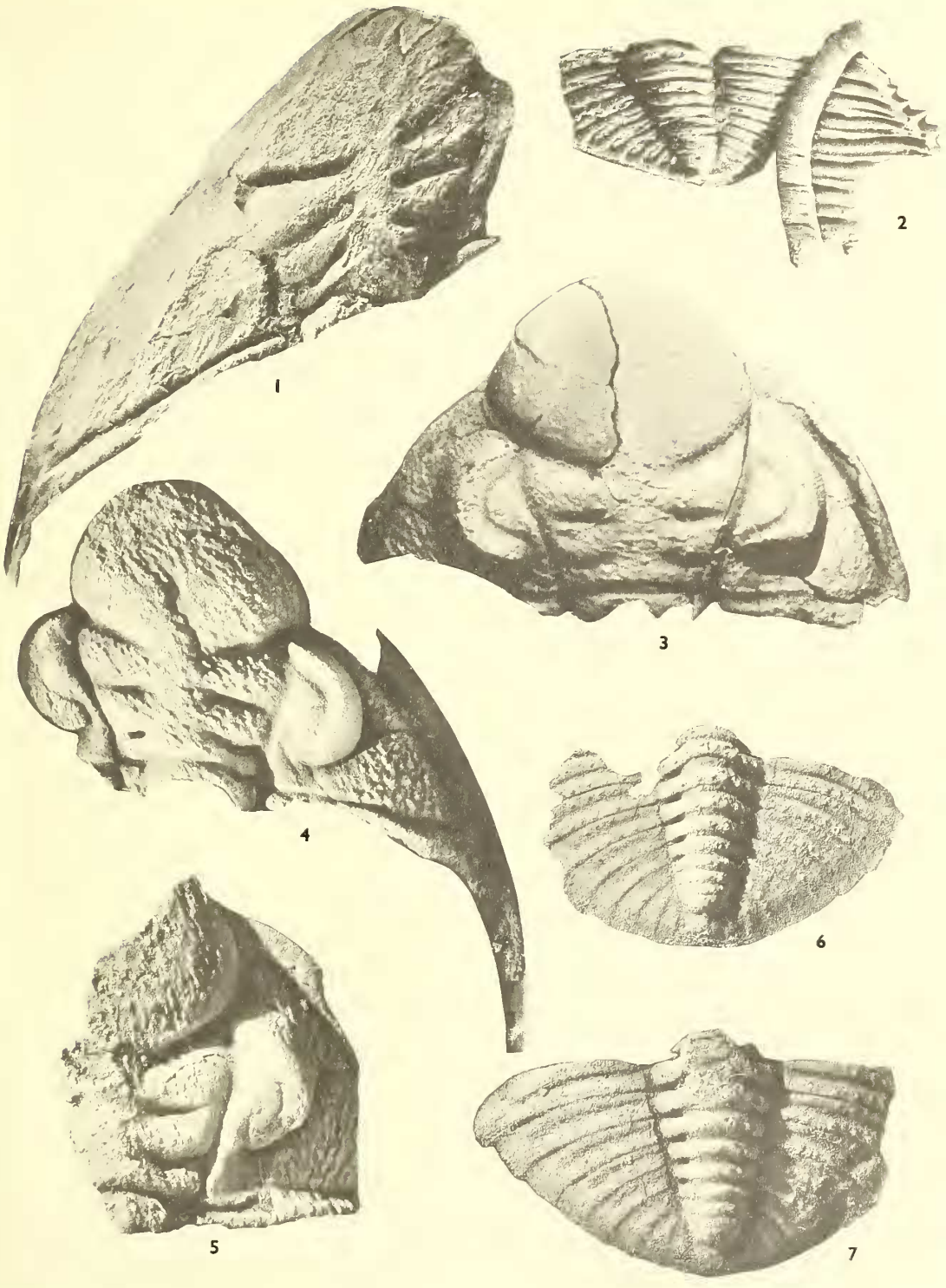
EXPLANATION OF PLATE 84

All specimens whitened with magnesium oxide and all except fig. 2 illuminated from top left.

Figs. 1–2. *Delops obtusicaudatus* (Salter), Coldwell Beds, Coldwell, Westmorland. 1, Lectotype, SM A38682, internal mould of incomplete cephalon, figured by M'Coy (1851), pl. 1G, fig. 15, ×2½. 2*a*, BM In55901, latex cast of external mould of small, compressed pygidium, showing narrow border, illumination from top right, ×2½. 2*b*, BM In55901, latex cast of external mould of doublure showing broad and rounded nature, illuminated from top right, ×2½.

Figs. 3–7. *Delops nobilis marri* subsp. nov. 3, Holotype, HUR/1D/384, internal mould of almost undistorted cephalon, Cautley, NW. Yorkshire, ×2½. 4, Paratype, SM A38678, Helm Knott, near Sedbergh, NW. Yorkshire; internal mould of well-preserved cephalon, ×2½. 5, Paratype, HUR/1D/6, Cautley, NW. Yorkshire; internal mould of part of cephalon showing glabellar lobation, ×2½. 6, Paratype, HUR/1D/177, Cautley, NW. Yorkshire; latex cast of external mould of pygidium, ×2·1. 7, Paratype, HUR/1D/177*a*, Cautley, NW. Yorkshire; internal mould of almost complete pygidium, ×2½.



RICKARDS, *Delops*

upon either internal or external moulds of the pygidium and may be contrasted in this respect with the cephalon which, in spite of its generally poor preservation, shows the tubercles. This suggests that lack of tubercles on the pygidium is not merely a result of their obliteration by compression. There are nine pygidial pleurae of which the anteriormost five closely correspond to the rings on the pygorachis. Both the pleural and interpleural furrows are well developed and extend to the narrow border of the pygidium.

Remarks. D. obtusicaudatus does not seem to occur outside the Lake District, and the headshields obtained from Coldwell, &c., and contained in the various museums, are not well preserved. Nevertheless, the general pattern of a coarsely tuberculate semicircular cephalon can usually be ascertained and in occasional better-preserved specimens the nature of the various biocharacters can be seen.

The specimen originally figured by M'Coy (1851, pl. 1G, fig. 15), and designated here as the lectotype, was not included by Salter in his 1873 catalogue of the fossils contained in the then Cambridge Museum. As a result the fossil was missing for many years and in fact was only found by Dr. Forbes and the writer in 1963. The pygidium figured at the same time as the headshield could not be found and it may be either a composite drawing or an idealized drawing.

Delops nobilis nobilis (Thomas)

Plate 85, figs. 7, 10

1900 *Phacops* (*Dalmania*) *nobilis* Thomas, pp. 617–18, pl. 34, figs. 1–3.

Holotype. The specimen figured by Thomas (1900), pl. 34, fig. 1, now housed in the Oxford University Museum, specimen number C24–25, and refigured herein as Plate 85, figs. 7 and 10; internal and external moulds of almost complete specimen.

Dimensions of holotype. Length of glabella 25 mm.; approximate width of cephalon 38 mm.

Horizon and locality of holotype. Wenlock Shales, 1 mile east of Builth, 150 yards from bank of R. Wye.

Other material. Specimens in the University Museum, Oxford.

Diagnosis. Exoskeleton moderately large, tuberculate, and with a prominent, rounded doublure; cephalon semicircular, anterior border interrupted by protruding frontal glabellar lobe, border furrow well developed except anteriorly; eyes large, crescentic, extending from top of 3p lobes to midway between 1p furrows and occipital furrow; cephalic axial furrows widen steadily to top of 3p lobes and then widen more rapidly to produce a club-shaped glabella; 1p, 2p, and 3p lobes graduated and increasing in size anteriorly, 2p and 3p lobes abaxially fused so that 2p furrows do not reach axial furrows; frontal lobe large, swollen, protruding beyond anterior cephalic margin, with a posteriorly positioned pit; whole cephalon ornamented with coarse tubercles elongated parallel to length of fossil; pygidium well segmented, pygorachis with nine to eleven axial rings; pygidial margin showing faint tendency to denticulation of the anteriormost segment.

Description. This species was thoroughly described and reconstructed by Thomas and it remains only to note that the 2p furrows do not extend to the axial furrows as depicted by him (pl. 34, fig. 3). This interpretation is clearly based upon the holotype, which has the 2p furrow crushed. Other specimens contained in the University Museum, Oxford

(e.g. C558), show the deep 2p furrows typical of *Delops* which fade out before the axial furrows are reached. Finally, the pygidia examined by the writer show a slight denticulation of the anterior-most pleural segment of the pygidium.

Remarks. Delops nobilis nobilis differs from *D. obtusicaudatus* mainly on the characters of the pygidium, which in the case of the former species has fewer axial rings, a denticulation of the margin, and numerous tubercles similar to those on the rest of the exoskeleton.

Delops nobilis marri subsp. nov.

Plate 84, figs. 3–7; Plate 85, figs. 8, 9; text-fig. 1*a*

1892 *Phacops torvus* Wyatt-Edgell, M.S.; Marr, p. 537.
?1911 *Phacops obtusicaudatus* Watney and Welch, pp. 217, 223, 227, 228, 234.
1913 *Phacops* (*D.*) *obtusicaudatus* Marr, pp. 12, 17.
1913 *Phacops* (*Dalmanites*?) sp. 1, Marr, p. 17.
1913 *Phacops* (*Dalmanites*) sp. 2, Marr, p. 17.

Holotype. HUR/1D/384, the headshield figured on Plate 84, fig. 3, internal mould of almost complete cephalon.

Dimensions of holotype. Width of cephalon 35 mm.; length of glabella 19 mm.; max. width of glabella 16 mm.

Horizon and locality of holotype. Basal Ludlow limestone, Zone of *nilssoni-scanicus*, Bluecaster.

Horizon. Rare in the top few feet of the Brathay Flags (Wenlock Series) and common in the bipartite limestone immediately overlying the Brathay Flags; rare in the Upper and Middle Coldwell Beds of the Lake District.

Localities. Bluecaster, and mouth of Backside Beck, Cautley, north of Sedbergh; Troutbeck, Westmorland.

Material. Over 100 specimens.

Diagnosis. Exoskeleton moderately large with a flattened doublure; cephalon semicircular, anterior border interrupted by protruding frontal glabellar lobe; genal spines long and robust; border furrow well developed except anteriorly; occipital ring with mesial tubercle; eyes large, crescentic, extending from top of 3p lobes to 1p grooves; cephalic axial furrows widen steadily from occipital ring; 1p, 2p, and 3p lobes graduated

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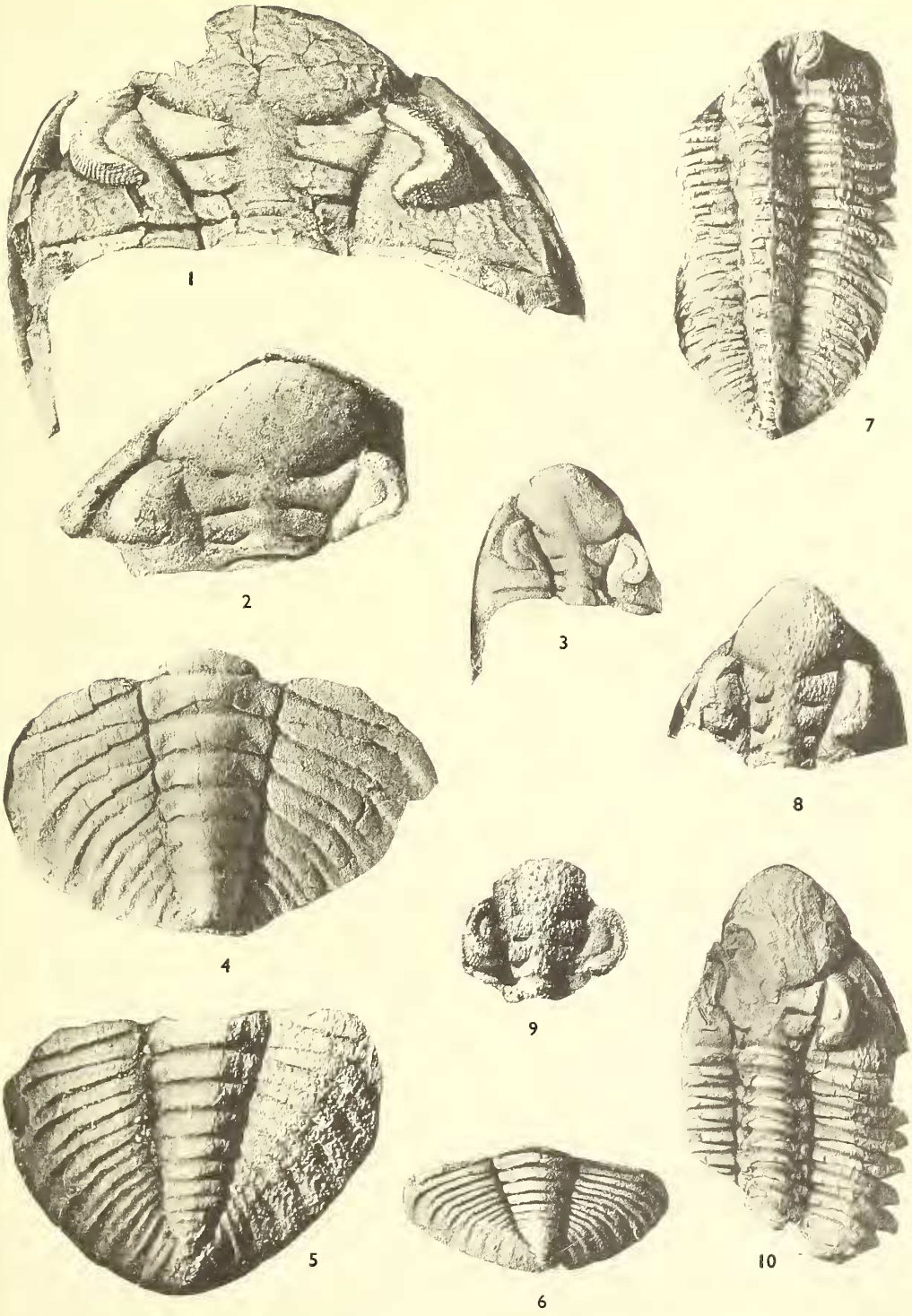
EXPLANATION OF PLATE 85

All specimens whitened with magnesium oxide.

Figs. 1–6. *Struveria howgillensis* sp. nov. Cautley, NW. Yorkshire. 1, Holotype, HUR/1D/260, latex cast of external mould, ×2½. 2, Paratype, HUR/1D/1, latex cast of external mould showing frontal cephalic margin, ×2½. 3, Paratype, HUR/1D/208, internal mould of headshield of young specimen, ×2½. 4, Paratype, HUR/1D/161*a*, internal mould of somewhat flattened pygidium, ×2½. 5, Paratype, HUR/1D/383, almost undistorted pygidium, internal mould, ×2½. 6, Paratype, HUR/1D/197, internal mould of small, compressed pygidium, ×2½.

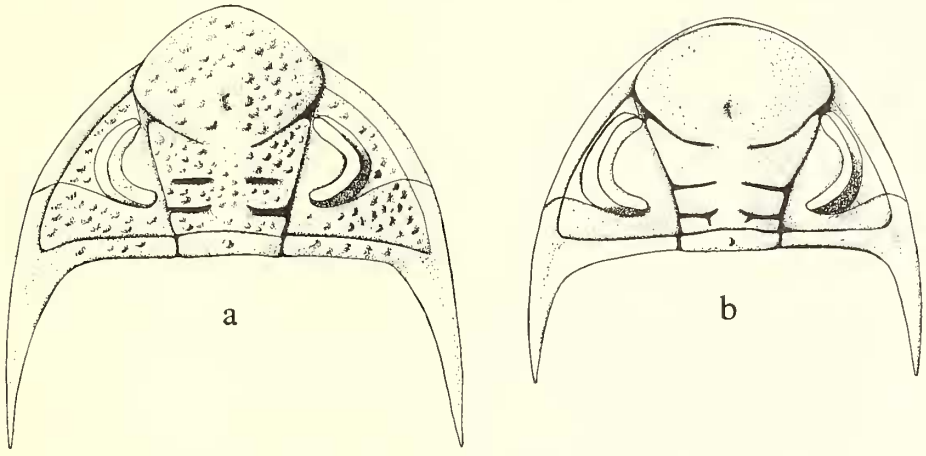
Figs. 7, 10. *Delops nobilis nobilis* (Thomas). 1 mile east of Builth. 7, Holotype, OUM C25, latex cast of external mould of almost complete well-preserved specimen, ×1. 10, Holotype, OUM C24, counterpart of OUM C25, internal mould of part of thorax and cephalon, ×1.

Figs. 8, 9. *Delops nobilis marri* subsp. nov. Cautley, NW. Yorkshire. 8, Paratype, HUR/1D/19, internal mould of small cephalon, ×2½. 9, Paratype, HUR/1D/7, latex cast of external mould of glabella of a young specimen showing nature of tuberculation, ×2½.



RICKARDS, *Struveria* and *Delops*

and increasing in size anteriorly, 2p and 3p lobes fused abaxially so that 2p furrows do not reach axial furrows; frontal lobe large, swollen, protruding beyond the cephalic margin, and having a posteriorly positioned pit; whole cephalon ornamented with large tubercles interspaced with more numerous smaller ones; pygidium tuberculate, pygorachis with nine to ten axial rings and pleural regions with six to eight pleurae; pygidium margin showing at least three lateral denticles, doublure flat; hypostome tuberculate, with three denticles along posterior margin, anterior wings and maculae similar to *Chattiaspis*.



TEXT-FIG. 1. *a*, *Delops nobilis marri* gen. et subsp. nov.; reconstruction of cephalon, approx. ×1·5. *b*, *Struveria howgillensis* gen. et sp. nov.; reconstruction of cephalon, approx. ×1·5.

Description. In all its biocharacters the subspecies *marri* differs only in relative proportions from the type subspecies. The cephalon is of similar shape and size but the eyes are situated rather more anteriorly than in *nobilis* s.s. and extend from the top of the 3p lobes to the level of the 1p furrows. In *nobilis* s.s. the frontal lobe is more swollen than in *marri* and thus the axial furrows widen steadily in the latter, but the rate of widening increases suddenly after the 3p lobes in the former. The tubercles are rounded and not elongated parallel to the axis as in the case of the type subspecies.

The pygidium has nine or ten axial rings but no specimens have been found having eleven axial rings. In the cases of those specimens with eight pygidial pleurae the anterior-most five correspond with axial rings. The interpleural furrows reach the pygidial margin whilst the pleural furrows reach only three-quarters of the way to the margin. The denticulation of the anterior pygidial margin is a distinctive feature of the subspecies, there being three distinct denticles and other less distinct ones posteriorly. As in *nobilis* s.s. the doublure is broad but in *marri* it is flat and not rounded.

Remarks. The headshields and pygidia from the Howgill Fells described here as *D. n. marri* are regarded as conspecific on the grounds of identical ornamentation and association, in the absence of other ornamented forms. Marr (1913) recorded *P. obtusicaudatus* from the same beds but all the specimens collected by the writer, together with those examined in museum collections, show that only one tuberculate phacopid occurs at this horizon in the Howgill Fells. The forms listed by Marr (1892, pp. 537, 538) as